National Aeronautics and
Space Administration

FY 1995
SAFETY PROGRAM
STATUS REPORT

NASA Safety and Risk Management Division
Office of Safety and Mission Assurance
Washington, D.C. 20546

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SAFETY PROGRAM OVERVIEW

During FY 1995, the NASA Safety and Risk Management Division continued to enhance the quality and productivity of its safety oversight function. Ongoing initiatives in areas such as training, risk management, safety assurance, operational safety, and safety information systems contributed to the safety and success of activities throughout the Agency.

The Safety and Risk Management Division continued to sponsor development of a centralized intra-agency safety training program. The major accomplishment in this area continues to be the success of the NASA Safety Training Center (NSTC). This facility is located at the Johnson Space Center (JSC) and provides quality NASA-specific safety training at lower cost. The NSTC trained over 3,000 students during FY 1995, more than double that of the previous year. Thirty nine different courses were offered during FY 1995 covering a broad range of safety-related topics.

During FY 1995, the Safety and Risk Management Division sponsored the development of numerous new courses for presentation by the NSTC. They included: Cryogenic Safety, Process Safety Integration, Explosive Safety Program Management, Human Factors in Accident Investigation, Practical Probabilistic Risk Assessment, Breathing Air Devices, Wind Tunnel Safety, and Vacuum System Safety.

NASA Headquarters continued efforts to fully institutionalize safety into all programs and processes through the development and implementation of a safety career training program. This program is designed to enhance the career scope and upward mobility of NASA safety professionals and program and project managers. The program will ensure that NASA management has the necessary safety skills with emphasis on application to day-to-day responsibilities.

The Safety and Risk Management Division continued its participation with the Federal Advisory Committee for Occupational Safety and Health (FACOSH) to ensure NASA remains abreast of all new regulations, initiatives, issues, etc. NASA continued work with the FACOSH Training Subcommittee to solve the problem of providing effective training to employees at reasonable cost. FY 1995 saw further implementation of NASA's agreement with the Occupational Safety and Health Administration (OSHA) that allows OSHA training courses to be presented by the NSTC. NASA also participated in "Reinvention of OSHA" activities to help develop a proposed plan for how OSHA would operate in the future.

The Safety and Risk Management Division sponsored a number of research and development activities conducted at Headquarters and various NASA Centers which were designed to address unique NASA safety needs:

> The Lewis Research (LeRC) Center completed the development of a Process Safety Management Program in compliance with new OSHA regulations. The program was tested at LeRC and the program documents (standards, operating procedures, etc.) are being made available for Agencywide implementation.

Goddard Space Flight Center (GSFC) efforts to develop a Facility System Safety Handbook were completed in FY 1995. This document provides comprehensive procedures for standardized facility system safety engineering techniques to be used throughout NASA. The draft document was distributed for review by safety officials at each NASA Center. The final document is scheduled to be published in 1996.

The Safety and Risk Management Division completed development of a Lessons Learned Information System. The software was made available throughout NASA and the Department of Defense and training sessions on the system were held. This automated database will be a valuable tool for use by safety personnel, program managers, and engineers.

GSFC continued its research to develop effective fire protection for high bay structures. FY 1995 activities included the study of smoke movement and smoke layer development in high bays.

A parametric fire suppression study is being sponsored at the White Sands Test Facility (WSTF). The goal is to define a set of fire suppression deluge water demand curves for varying oxygen percentages, pressures, and materials.

The Stennis Space Center (SSC) is developing an improved electro-optical Hydrogen fire sensor capable of eliminating false alarms due to light sources such as welding operations, lightning, and reflections from flare stacks. Stennis is also testing the feasibility of a low cost hand-held Hydrogen fire imager for personnel to carry for safe entering and exiting of Hydrogen handling areas.

Ames Research Center (ARC) and SSC continued their joint effort to develop an aerial reconnaissance system that would provide responsible officials with real-time damage assessment data in the event of an emergency/disaster. This effort is being coordinated with the Federal Emergency Management Agency (FEMA). The goal is to utilize NASA technology to meet a critical national need for rapid-response disaster assessment.

A laboratory risk evaluation program is being sponsored at the Langley Research Center (LaRC) to enhance capabilities in monitoring the safety aspects of laboratory operations and resolving unsafe practices. This program will also increase safety awareness at the operator level and establish a separate Configuration Management Program for laboratory-type facilities.

NASA continued to work with the Air Force on a joint test and evaluation program for graphite/epoxy composite overwrapped pressure vessels. This relatively new technology is becoming more widely used in the aerospace industry due to the potential for weight savings. There are a number of unique safety concerns for personnel working with and around these vessels. The purpose of the research program is to better define the design, handling, and transportation requirements necessary to use these vessels safely within NASA.

NASA continued its initiatives to control trends, major causes or sources of fatalities and lost time disabilities, and to lower overall compensation costs. The Safety and Risk Management Division sets annual lost time injury/illness frequency rate goals for each Center. The goals are based on a number of parameters including previous performance as compared to the Center's own past record and to the overall Agency rate, improvement desired, and projected worker hours. This effort is part of an overall safety motivation program that strives to continually reduce injuries in the workplace.

The Safety and Risk Management Division continued participation on NASA's "Reinvention of Government" Team to ensure safety concerns are properly addressed and program changes yield positive impacts on NASA's safety program.

The Safety and Risk Management Division continued to participate on various Joint Army, Navy, NASA, Air Force (JANNAF) subcommittees involved in the development of standards/codes and resolving issues in the areas of safety, explosives, propellants, and hazardous material handling and storage operations.

NASA participated in the National Highway Traffic Safety Administration Drunk and Drugged Driver Awareness Campaign and instituted the Department of Transportation's "Four Seasons Approach" to traffic safety. The Safety and Risk Management Division distributed program planners for the Drunk and Drugged Driver Awareness Campaign to all NASA Centers.

NASA continued efforts at JSC to refine the Center's Safety and Health program to qualify for participation in OSHA's Voluntary Protection Program (VPP). A thorough review of JSC's program was conducted. The Senior Managers Safety Course was presented to all levels of JSC's management including the Center Director who demonstrated his support for JSC's VPP efforts.

The Safety and Risk Management Division distributed a second publishing of the NASA Operational Safety Management Reference Book. This three volume set provides easy reference to elements of NASA's Operational Safety Program including Occupational Safety and Health It is a compilation of Headquarters policy and requirements documents, standards, and other pertinent information that NASA safety personnel should have readily available in order to carry out their responsibilities.

NASA continued development of its Emergency Preparedness Program during FY 1995. The NASA Emergency Preparedness Plan and the NASA policy document that define the program were developed and were coordinated with the Centers and all Headquarters Codes All NASA Centers developed and enhanced programs designed to address their unique needs and to implement the NASA Emergency Preparedness Plan. NASA Headquarters established a requirement for the Centers to perform special self evaluations of their emergency preparedness programs and report the findings by January 1995. Lessons learned from these evaluations were shared throughout the Agency and corrective actions were initiated to address any problems noted. The Safety and Risk Management Division sponsored an Emergency Preparedness Coordinators Meeting at the Kennedy Space Center, February 14 - 16, 1995. Specific meeting topics included Center program status reports, emergency information systems, geographic information systems, NASA participation in the Federal emergency preparedness exercise "RESPONSE 95" and revisions to NASA Emergency Preparedness Program documents.

NASA continued its active participation in the Federal Response Program and provided aerial reconnaissance support in response to the flooding problems experienced in the Southern United States during 1995. The NASA Emergency Preparedness Program actively participated with the Federal Emergency Management Agency in their "RESPONSE 95" exercise in May 1995. This exercise simulated a major hurricane striking New Orleans. NASA personnel participated in numerous exercise design and training activities over a period of 14 months prior to the exercise. NASA's Stennis Space Center and Michoud Assembly Facility were directly involved in the hurricane scenario and the Marshall Space Flight Center (MSFC) ran a tornado drill that simulated the possibility of such secondary storms striking that area. NASA emergency preparedness personnel from Headquarters and other NASA Centers participated in support, observation, and evaluation capacities. The exercise turned into a real-time event when an actual storm, causing heavy flooding, struck the New Orleans area during the week of the exercise. NASA made the transition from exercise to real-time event and supported FEMA in their response activities.

The NASA Safety and Risk Management Division continued to place emphasis on safety visibility and awareness at periodic Safety and Mission Assurance Directors Meetings. The Meetings provide a forum for the exchange of information and the discussion of safety related issues.

During FY 1995 NASA supported the Forty-Ninth Annual Federal Safety and Health Conference in San Diego, California. NASA was represented by a number of Centers and the Headquarters Safety and Risk Management Division. Headquarters compiled the presentations and handouts from the conference and distributed these throughout NASA for personnel who were unable to attend.

The Safety and Risk Management Division sponsored a Fire Protection Meeting in Denver, Colorado, May 24 - 26, 1995, in conjunction with the National Fire Protection Association's Annual Meeting. The purpose of the meeting was to review the fire protection programs at each NASA Center to establish Agency needs; to resolve policy and technical issues related to NSS 1740.11, "NASA Safety Standard for Fire Protection"; and to maintain a high level of emphasis on the overall NASA Fire Protection Program. Specific topics included identification of firefighting equipment needs, emergency preparedness coordination, use of the Emergency Information System software, functional management self-assessments, and lessons learned.

The Safety and Risk Management Division continued the design and active implementation of NASA's Functional Management Program to ensure proper assessment of NASA's safety programs. Under Functional Management, NASA Centers are responsible for conducting self assessments of their safety activities. Headquarters may assist with Center self assessments and may conduct its own spot checks of an installation. The Safety and Risk Management Division maintains a functional management questionnaire and numerous checklists based on 29 CFR 1960 and unique NASA requirements designed to assist the NASA Centers with self assessments of their safety programs. During FY 1995, The Safety and Risk Management Division participated in program assessments/spot checks at Ames Research Center, Marshall Space Flight Center, Stennis Space Center, Lewis Research Center and NASA's Independent Verification and Validation facility in Fairmont, West Virginia.

The Agency's dedication to the safety of personnel and the safe accomplishment of the NASA mission was highlighted on NASA Safety Awareness Day, held throughout the Agency in September 1995. A message from the Administrator, reaffirming his complete support of NASA's safety program, was broadcast to all NASA employees and Contractors. Each Center Director also addressed their personnel and numerous safety awareness related activities were conducted throughout the Awareness Day campaign.

NASA will continue to strive for maximum safety awareness and excellence in all activities. The Centers and Headquarters will continue to work together as a team to maintain an emphasis on safety.

James D. Lloyd
Director, Safety and Risk Management Division

FY 1995 NASA SAFETY STATISTICS

Fatalities	0
NASA Safety Reportable Lost Time Injuries/Illnesses	65
Costs	
Lost Wages	$110,212
Chargeback Billing	$7,300,000
Material Losses	* $1,989,401
Total Losses	* $9,399,613

* Does not include the X-31 Mishap. See Page 32 for details.

Information on injuries/illnesses and material losses was obtained from the NASA Mishap Reporting/Corrective Action System (MR/CAS). Lost wages and chargeback billing figures are from the Office of Workers' Compensation Programs (OWCP).

NASA OCCUPATIONAL INJURY/ILLNESS RECORD

As defined by OSHA, a recordable (i.e., compensable) lost time case is a work-related incident that results in either a nonfatal, traumatic injury that causes loss of time from work or disability beyond the day or shift when the injury occurred, or a nonfatal illness/disease that causes loss of time from work or disability at any time. NASA Safety organizations adhere to the OSHA reporting guidelines with some exceptions. For example, NASA Safety does not consider restricted duty or time taken for medical treatment to be lost time. Also, instances of injuries sustained during recreational activities or in parking lots during non-work-related activities are not included in the MR/CAS.

Table 1 shows the FY 1995 NASA Safety reportable injury/illness statistics for Federal employees at NASA Centers. The NASA Safety and Risk Management Division calculates injury/illness frequency rates based on the actual hours worked by each employee. The overall lost time frequency rate of 0.31 for NASA Federal employees is a 28% decrease from the FY 1994 rate of 0.43.

TABLE 1. NASA SAFETY REPORTABLE LOST TIME INJURIES/ILLNESSES BY INSTALLATION
ANNUAL REPORT FY 1995

			Lost Time Cases			
	Average No. of Employees	Hours Worked	No. Days	No. Cases	Freq.* Rate	1995 Goal
ARC	2,257	4,452,249	90	16	0.72	0.59
DFRC	451	972,736	5	2	0.41	0.65
GSFC/WFF	3,826	6,697,004	116	10	0.30	0.38
HQ	1,698	3,047,669	179	13	0.85	0.47
JSC/WSTF	3,759	6,471,476	45	2	0.06	0.36
KSC	2,347	3,837,167	43	5	0.26	0.37
LARC	2,617	5,286,319	11	5	0.19	0.33
LERC	2,370	4,593,350	7	5	0.22	0.44
MSFC	3,241	5,815,999	64	6	0.21	0.38
SSC	219	451,908	16	1	0.44	0.42
NASA	22,785	41,625,877	576	65	0.31	0.40
1994	23,954	42,820,364	842	92	0.43	0.40

* Lost Time frequency rate = Number of lost workday cases per 200,000 hours worked.

Figure 1 shows how the FY 1995 NASA Safety reportable lost time injury/illness frequency rates for Federal employees at NASA Centers compare to the individual Center goals set by the Safety and Risk Management Division and the overall NASA goal of 0.40. FY 1995 was one of the best in recent history with respect to lost time injury/illness performance. The Agency more than met its goal and 7 out of 10 NASA Centers met their individual goal.

Figure 2 plots the NASA Safety reportable lost time frequency rates for the last 10 years. The plot shows a relatively narrow range of rates during this period, from 0.31 to 0.48. The 1995 Agency rate of 0.31 was the lowest in the last ten years.

Figure 3 compares the FY 1995 NASA Safety reportable lost time frequency rates of NASA Federal employees at each Center with the previous year's rate and the total rate for the previous 3 years (FY 1992 - FY 1994). 1995 was an outstanding year for 7 out of 10 NASA Centers relative to their recent past performance.

Approximately 99% of NASA's FY 1995 lost time cases were injuries rather than illnesses. See Figure 4 for a breakdown of the major causes of lost time injuries Agencywide for FY 1995. The number one causes of lost time injury were slips/trips/falls (33%) and overexertion while lifting or moving objects (33%). Figure 5 provides a breakdown of the injured body parts. Back injuries were the most prevalent. More than one quarter of all NASA's FY 1995 lost time injuries were attributed to back injuries.

NASA LOST TIME RATES VS. GOALS
FY 1995

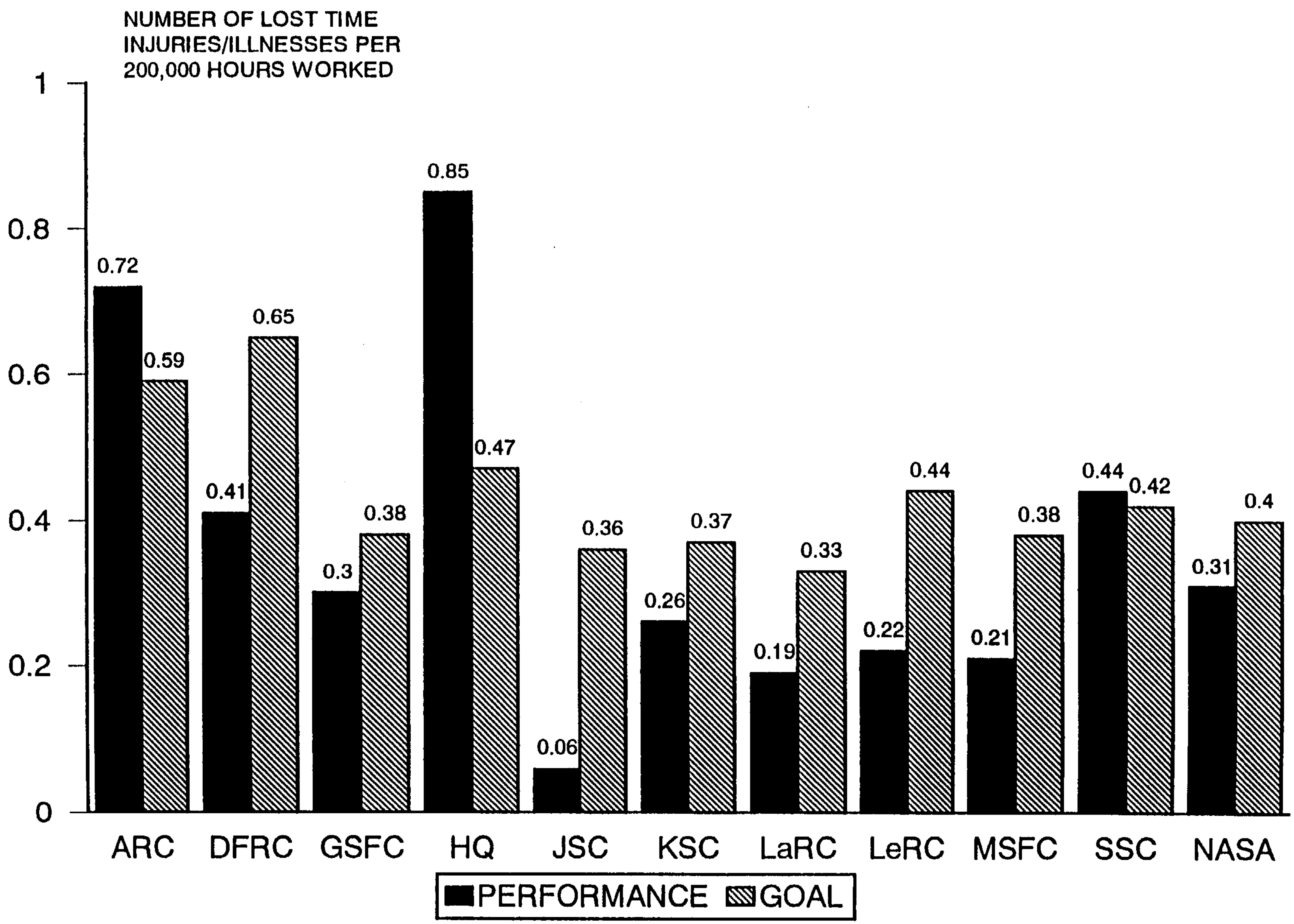


Figure 1

NASA LOST TIME INJURY/ILLNESS RATES

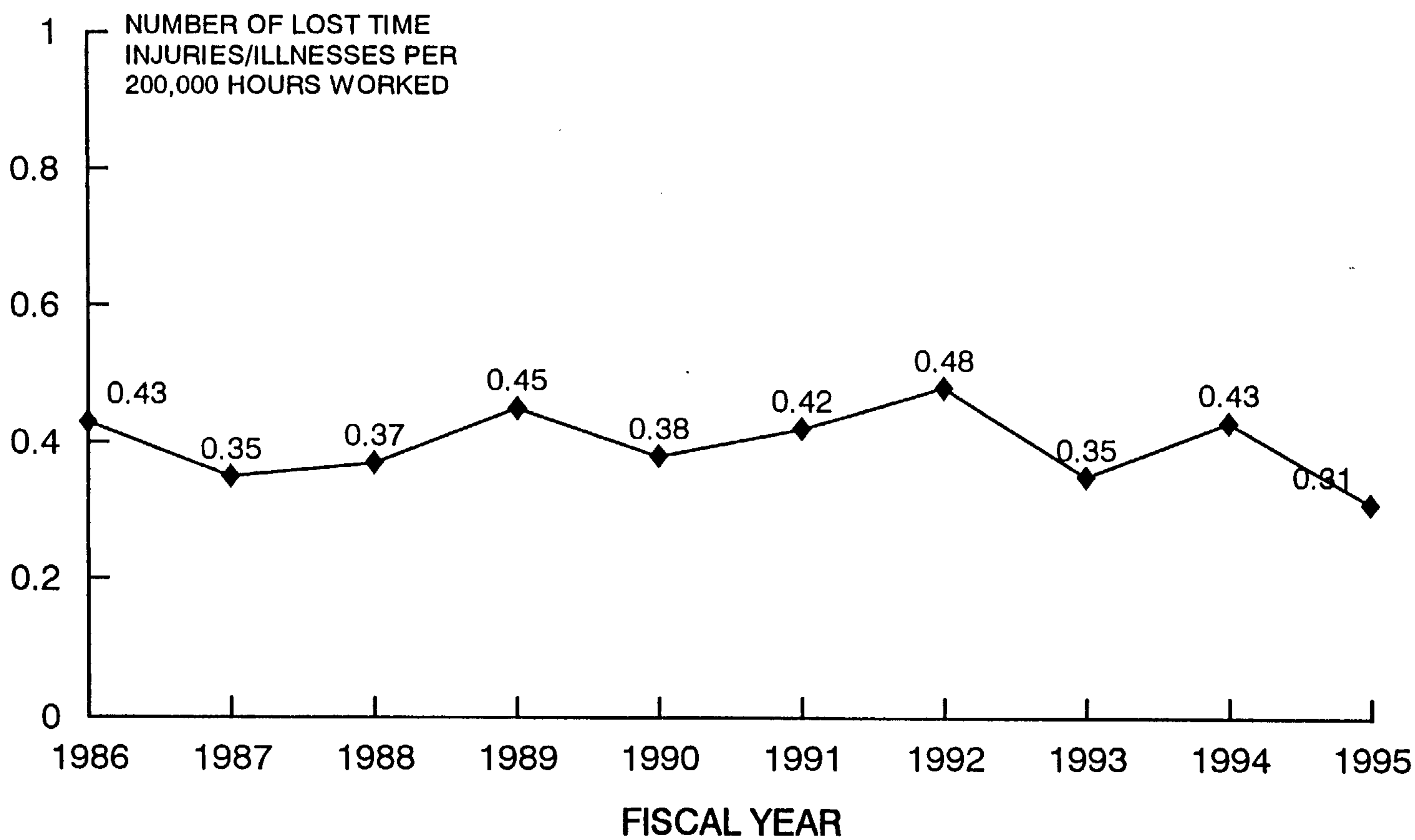


Figure 2

NASA CENTERS
LOST TIME INJURY/ILLNESS RATE HISTORY

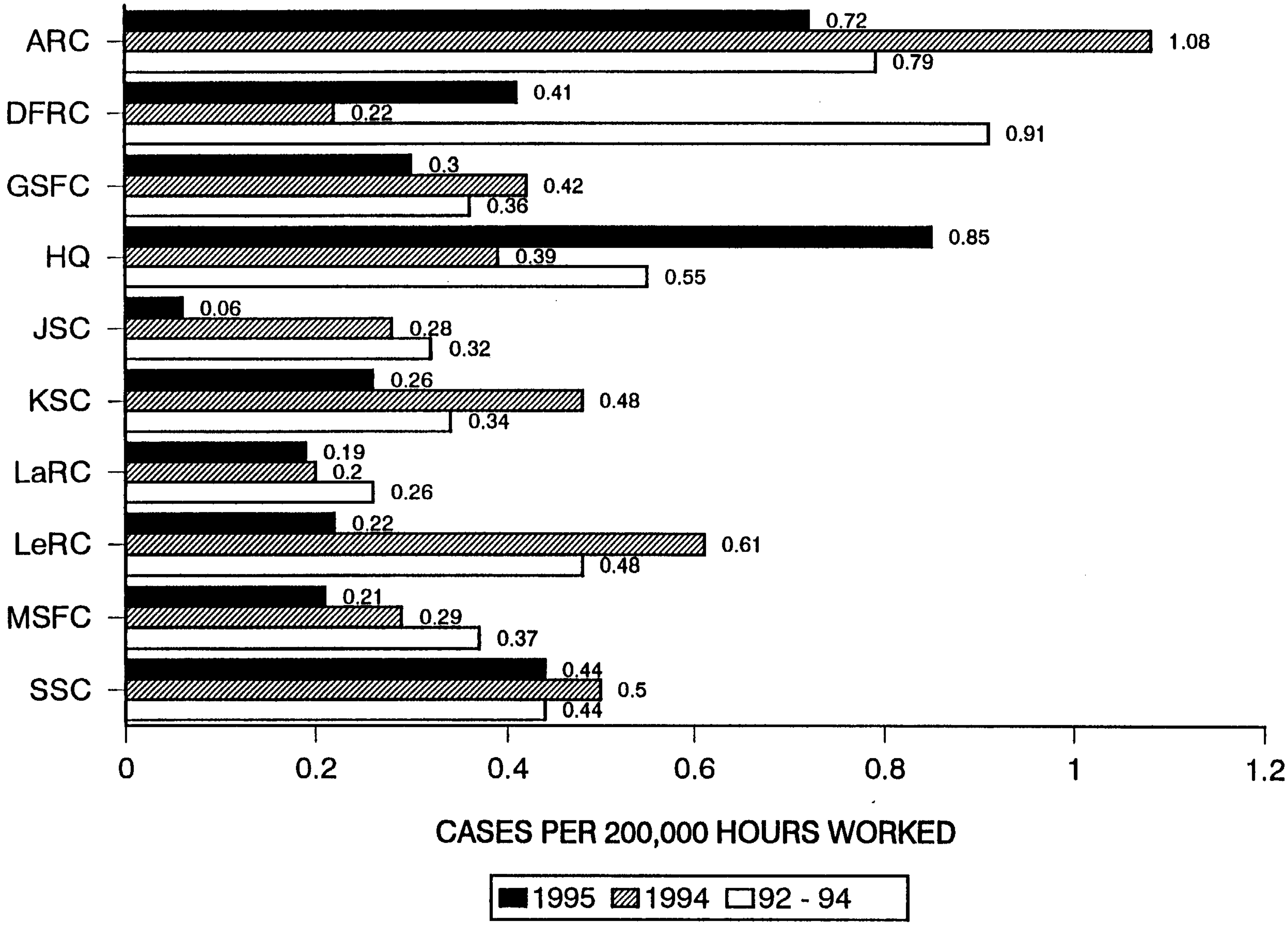


Figure 3

FY 1995 NASA LOST TIME INJURY CAUSES

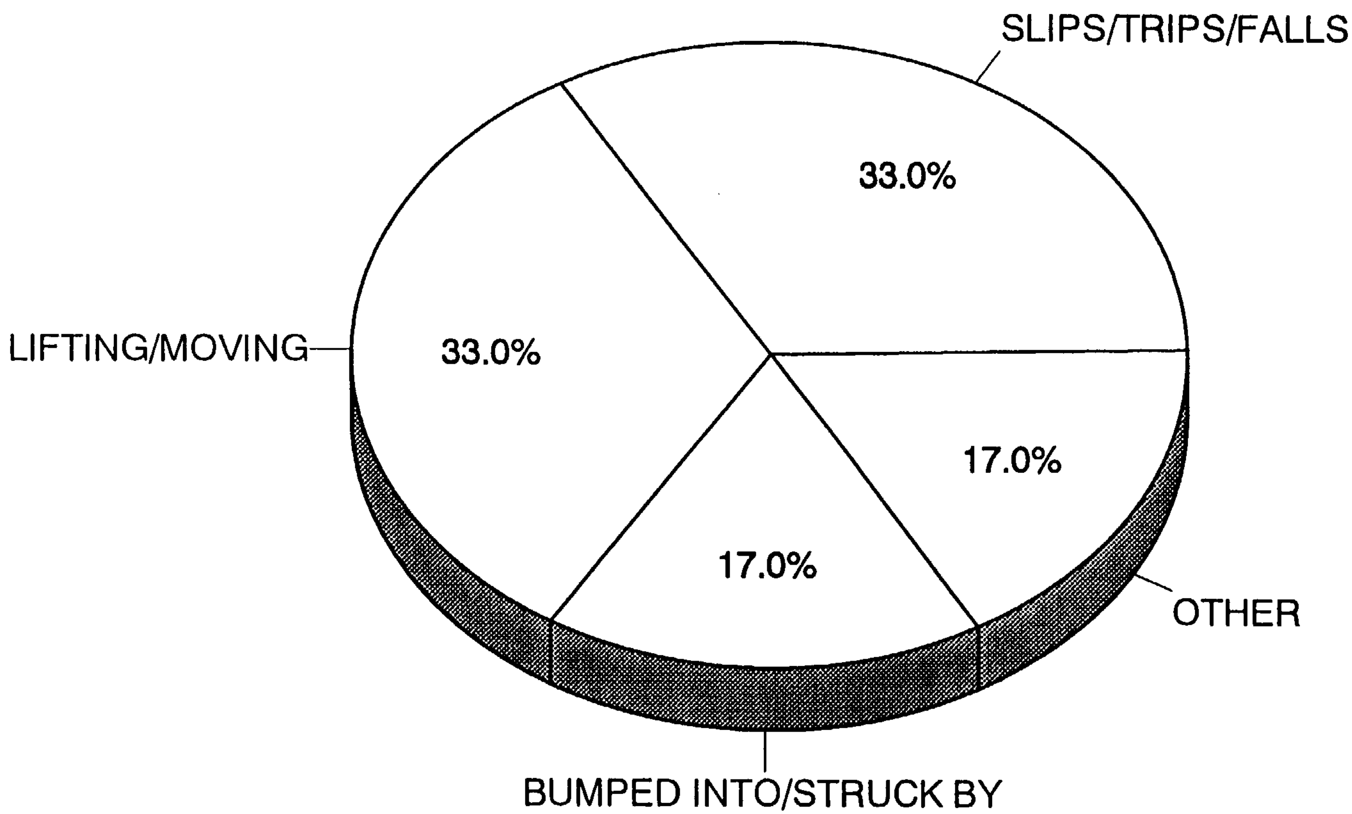


Figure 4

FY 1995 NASA LOST TIME INJURY BODY PARTS AFFECTED

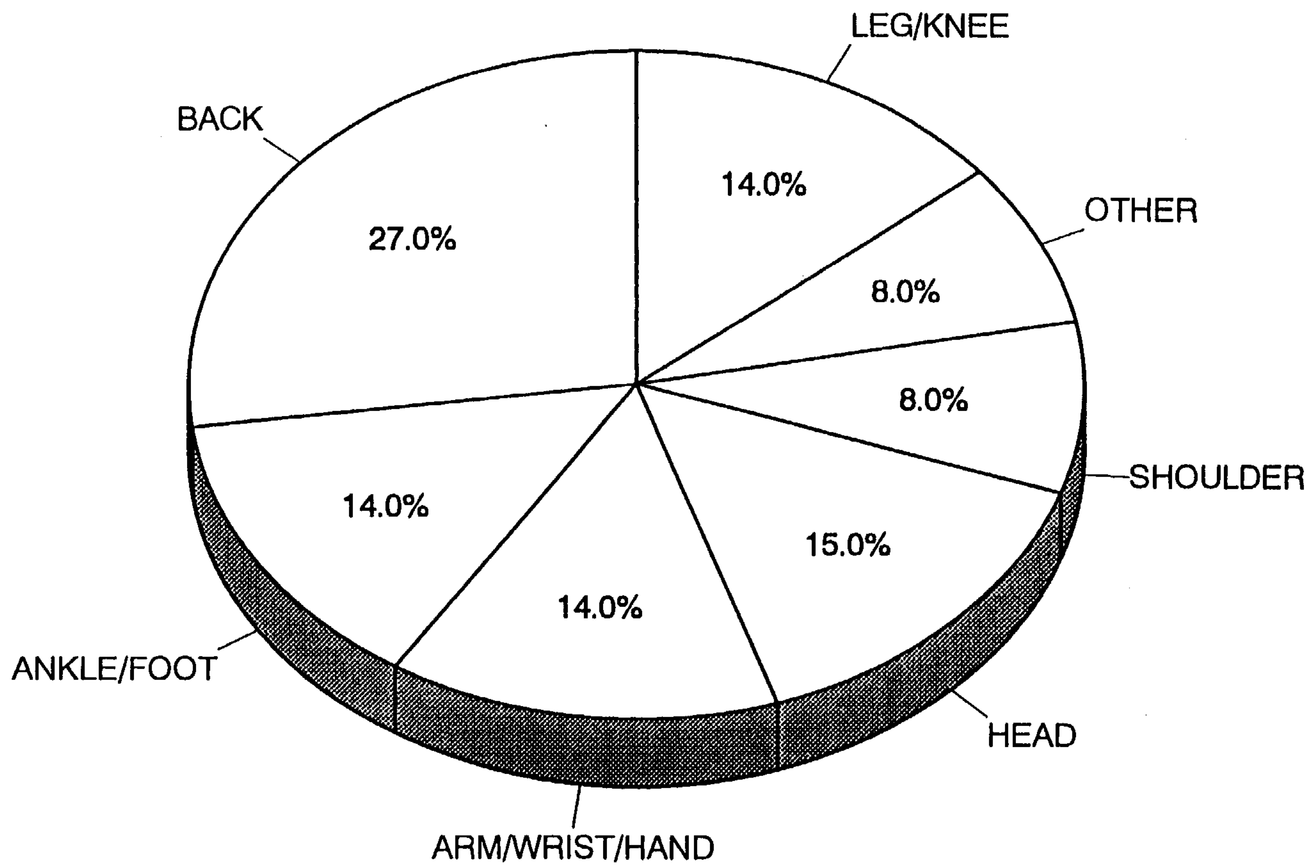


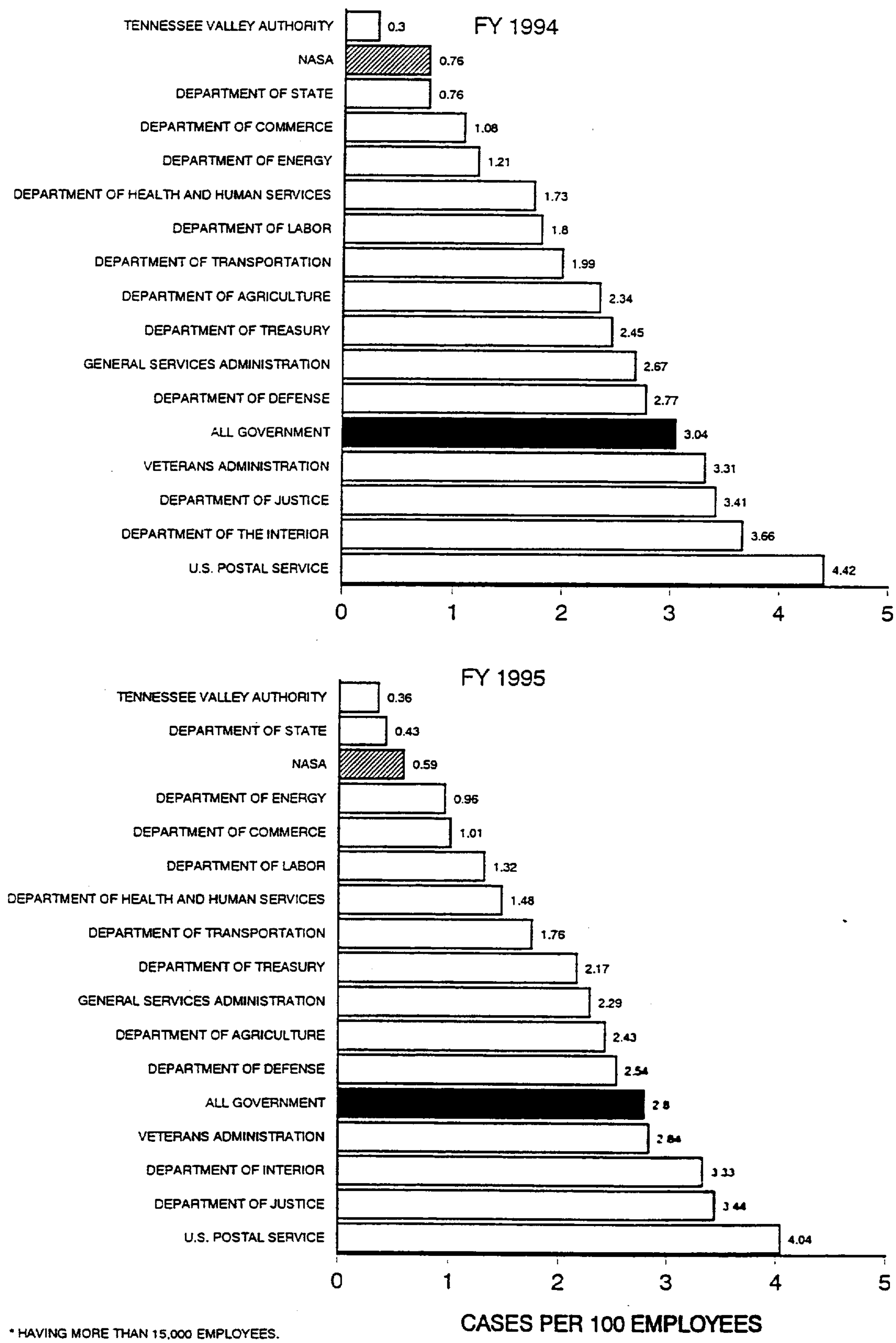
Figure 5

Comparison of NASA's injury/illness performance to that of other Government agencies and private industries can be made using the injury/illness incidence rates published by the Department of Labor. Figures 6 and 7 reflect these rates, which are based on OWCP data and determined according to the number of injury/illness cases per 100 employees. The incidence rate for NASA is usually higher than the frequency rate calculated by the NASA Safety and Risk Management Division. This is due to inherent differences in the two formulas and variations in the OWCP data. (OWCP tracks the number of claims made on OSHA recordable injuries and illnesses. It is possible for more than one claim to be made as the result of a given injury or illness.)

Figure 6 illustrates the relative position of NASA's lost time injury/illness performance compared to that of other Federal agencies having more than 15,000 employees in FY 1994 and FY 1995. Within this group of Federal agencies, NASA has ranked second or third lowest for the last ten years.

Figure 7 compares NASA's lost time injury/illness performance for the last 10 years against the total for all Federal agencies and select private sector industries. NASA's rates have been consistently lower than the total for all Federal Government and the private sector. The most recent statistics available from the Department of Labor for the private sector are for FY 1994.

LOST TIME INJURY/ILLNESS RATES IN SELECTED FEDERAL AGENCIES*



* HAVING MORE THAN 15,000 EMPLOYEES.

Figure 6

LOST TIME OCCUPATIONAL INJURY/ILLNESS RATES
PRIVATE SECTOR-ALL FEDERAL AGENCIES-NASA

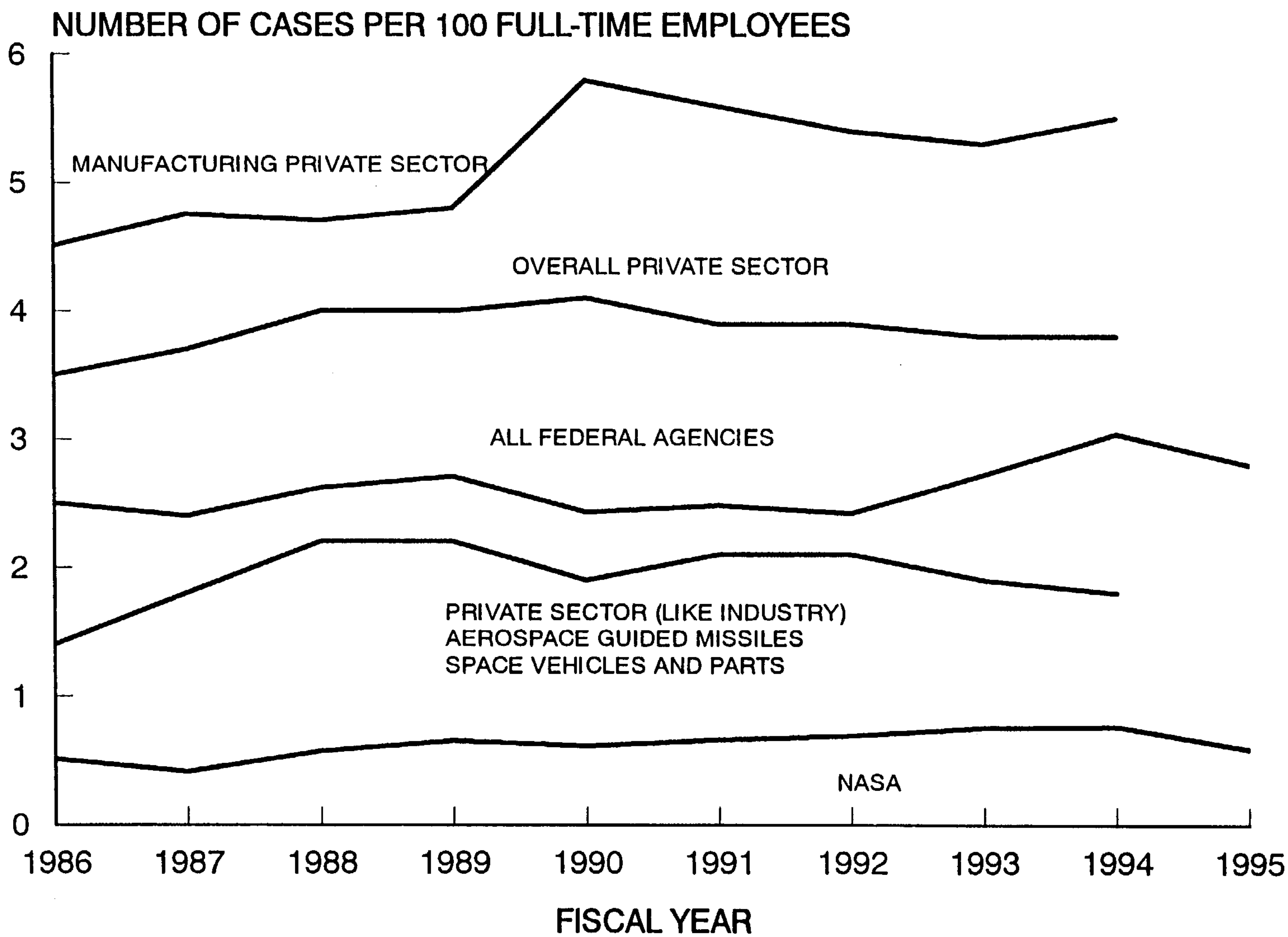


Figure 7

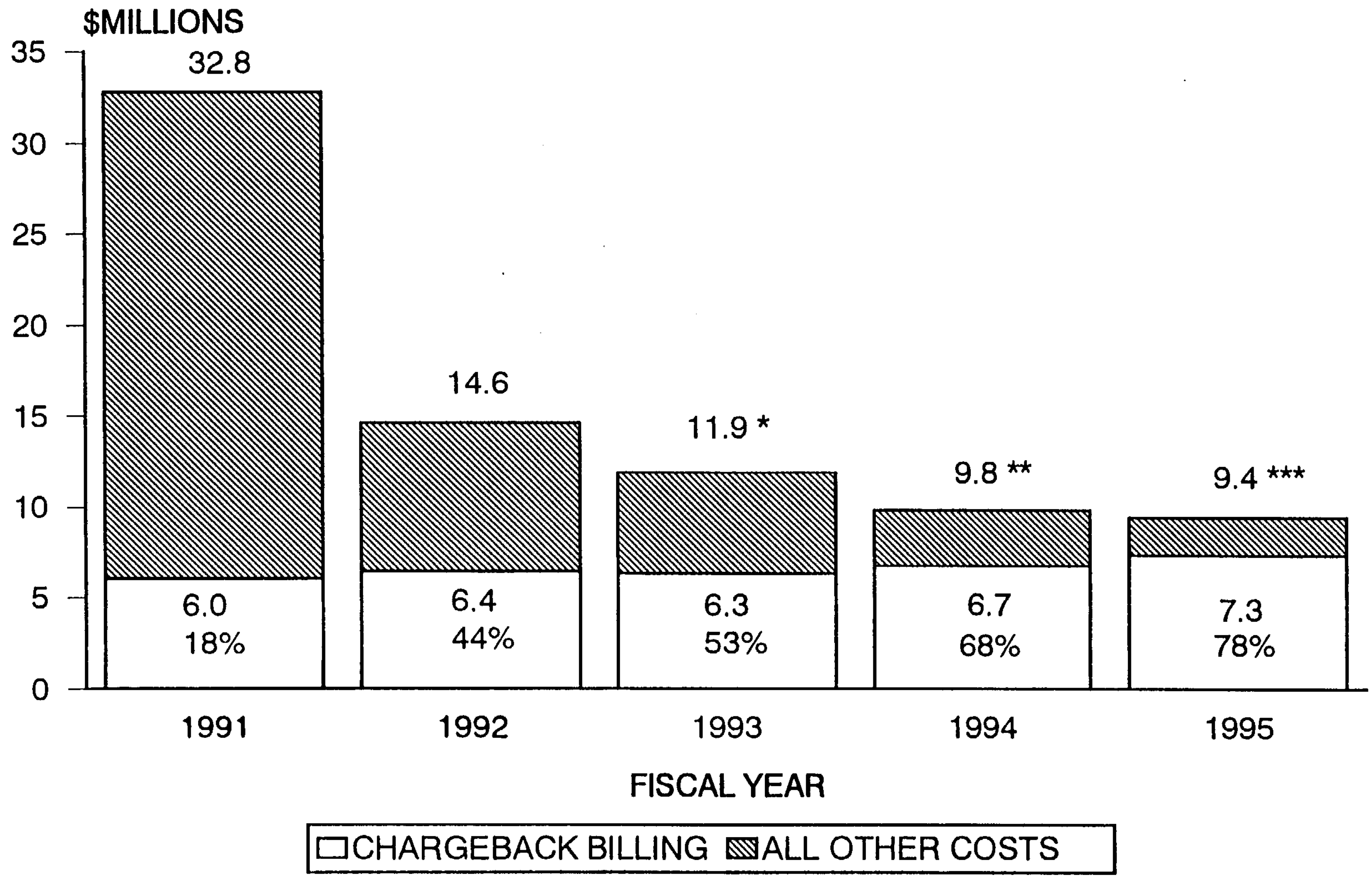
CHARGEBACK BILLING

Chargeback is defined by OSHA as a system under which the Department of Labor pays compensation and medical costs attributed to injuries that occurred after December 1, 1960, and then bills the agency that employed the individual who received compensation or benefits. This is a direct loss to NASA's operating budget. In any given year, most of the chargeback billing is a result of illnesses and injuries that occurred in previous years.

Figure 8 presents a 5-year history of NASA's total losses from chargeback billing and all other mishap and injury-related costs. These costs include lost wages (continuation of pay) as well as damage to or loss of NASA property in excess of $1,000. Of the $9.4 million loss for FY 1995, $7.3 million, or 78%, was paid out in chargeback billing costs.

Figure 9 illustrates the trend of chargeback billing in the Federal Government and NASA for the last 10 years. The Federal Government's chargeback billing costs have continued to rise each year with the sharpest increases occurring since 1988. From 1988 to 1995 the chargeback billing costs for all Federal Agencies increased by 67% from $1.1 billion to $1.835 billion. NASA's chargeback billing costs stabilized at around $5 million annually during the 1980's but has recently begun to increase as well. In comparison, NASA's chargeback billing costs have increased 46% since 1988. In general, the spiraling cost of health care is considered to be one of the major factors in the rising trend of chargeback billing.

TOTAL COST TO NASA DUE TO MISHAPS
CHARGEBACK VS. ALL OTHER COSTS



* DOES NOT INCLUDE LOSS OF MARS OBSERVER
** DOES NOT INCLUDE EARTHQUAKE DAMAGE AT CANOGA PARK
*** DOES NOT INCLUDE THE X-31 MISHAP

Figure 8

HISTORY OF CHARGEBACK BILLING COSTS FOR ALL FEDERAL AGENCIES AND NASA

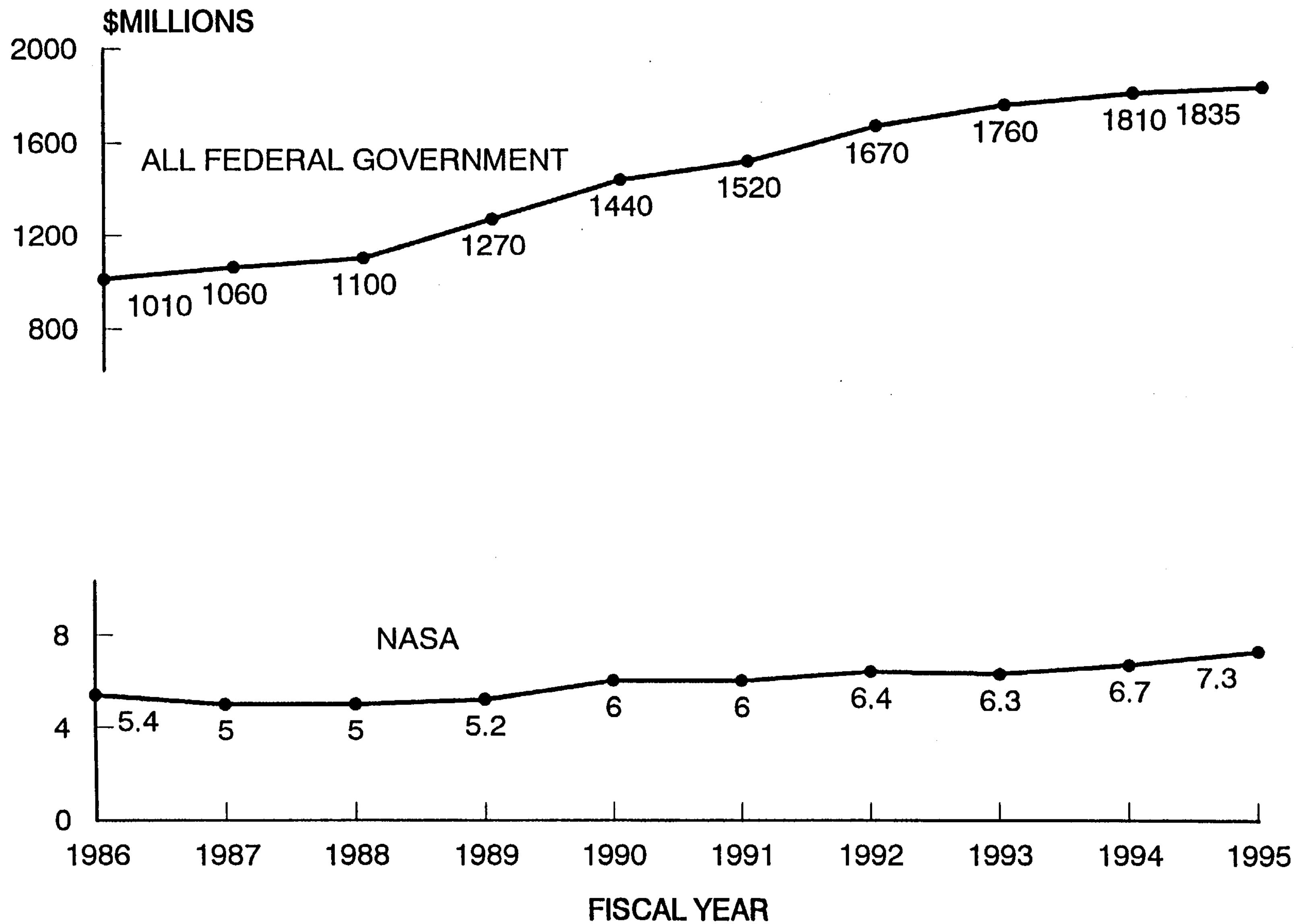


Figure 9

MATERIAL LOSSES

Tables 2A and 2B list the statistics for NASA material losses during FY 1995. Indirect costs associated with cleanup, investigation, injuries, or shutdown of operations are not included in these statistics.

Table 2A provides the number of equipment/property damage cases by equipment classification for each Center.

Table 2B provides the cost of equipment/property damage cases by equipment classification for each Center.

Figure 10 provides a percentage breakdown of equipment/property costs for FY 1995. The greatest contributors were two mishaps at LaRC that resulted in damage to prototype rotor blade assemblies (see Pages 32 and 35 for details.) Mishaps resulting in damage to NASA facilities were the second most costly. The primary contributor to facility damage was the flooding that occurred in the basement of the Advanced Combustion Rig facility at LeRC (see Page 33 for details).

Figure 11 illustrates the total costs of material losses over the last 5 years.

Figure 12 categorizes NASA's total equipment/property costs due to mishaps for the last 5 years from 1991 to 1995. Damage/loss of flight hardware was the number one contributor to NASA's material losses during that period. Mishaps resulting in damage to NASA facilities were the second most costly. Approximately 32% of NASA's material losses during the last 5 years are attributed to facility damage.

TABLE 2A. EQUIPMENT/PROPERTY DAMAGE BY INSTALLATION - ANNUAL REPORT FY 1995
NUMBER OF CASES BY EQUIPMENT CLASSIFICATION

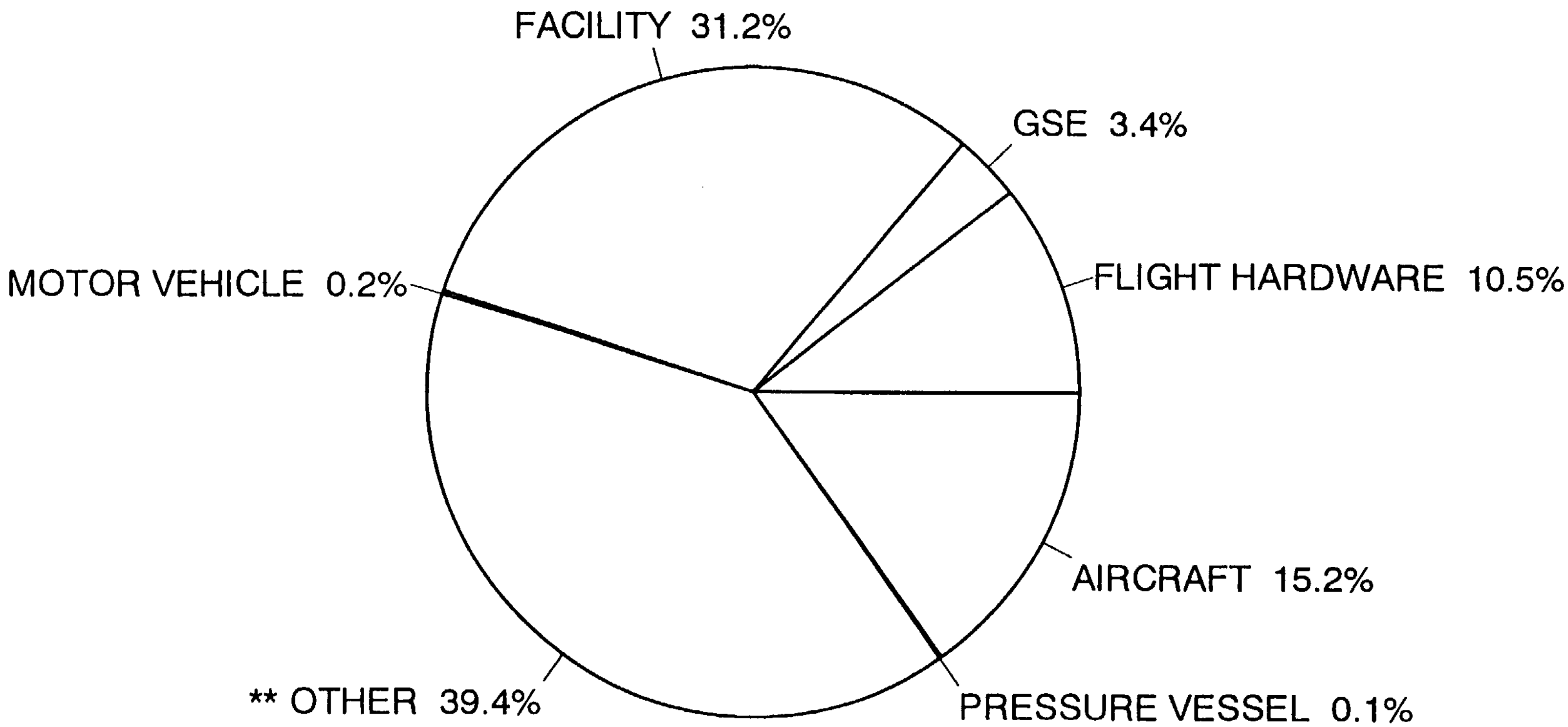
	Flight Hardware	Ground Support Equip.	Facility	Pressure System	Motor vehicle	Aircraft	Other	Total Cases
ARC	0	0	1	0	4	0	3	8
DFRC	0	0	0	0	0	1	0	1
GSFC/WFF	0	1	0	0	0	0	0	1
HQ	0	0	0	0	0	0	0	0
JPL	1	0	0	0	0	0	1	2
JSC/WSTF	2	1	4	0	0	5	3	15
KSC	8	4	2	0	1	0	0	15
LARC	0	0	3	0	0	0	2	5
LERC	0	1	5	2	1	2	0	11
MSFC	4	1	7	0	1	0	5	18
SSC	0	0	0	0	0	0	0	0
TOTAL	15	8	22	2	7	8	14	76
1994	12	10	15	2	14	1	23	77

TABLE 2B. EQUIPMENT/PROPERTY COSTS BY INSTALLATION - ANNUAL REPORT FY 1995
COST OF CASES BY EQUIPMENT CLASSIFICATION

	Flight Hardware	Ground Support Equip.	Facility	Pressure System	Motor Vehicle	Aircraft	Other	Total Costs
ARC	0	0	5,500	0	1,300	0	16,146	22,946
DFRC	0	0	0	0	0	(*100,000,000)	0	(*100,000,000)
GSFC/WFF	0	29,000	0	0	0	0	0	29,000
HQ	0	0	0	0	0	0	0	0
JPL	3,300	0	0	0	0	0	2,000	5,300
JSC/WSTF	10,033	1,385	8,604	0	0	295,495	76,160	391,677
KSC	70,518	36,100	280	0	1,094	0	0	107,992
LARC	0	0	98,920	0	0	0	674,089	773,009
LERC	0	800	477,195	1,200	500	6,150	0	485,845
MSFC	126,619	1,039	29,434	0	1,388	0	15,152	173,632
SSC	0	0	0	0	0	0	0	0
TOTAL	210,470	68,324	619,933	1,200	4,282	301,645	783,547	1,989,401
1994	482,921	68,450	**981,115	415,500	72,956	100,000	828,941	*2,949,883

* X-31 Mishap not included in totals. See Page 32 for details.
** Does not include earthquake damage at Canoga Park.

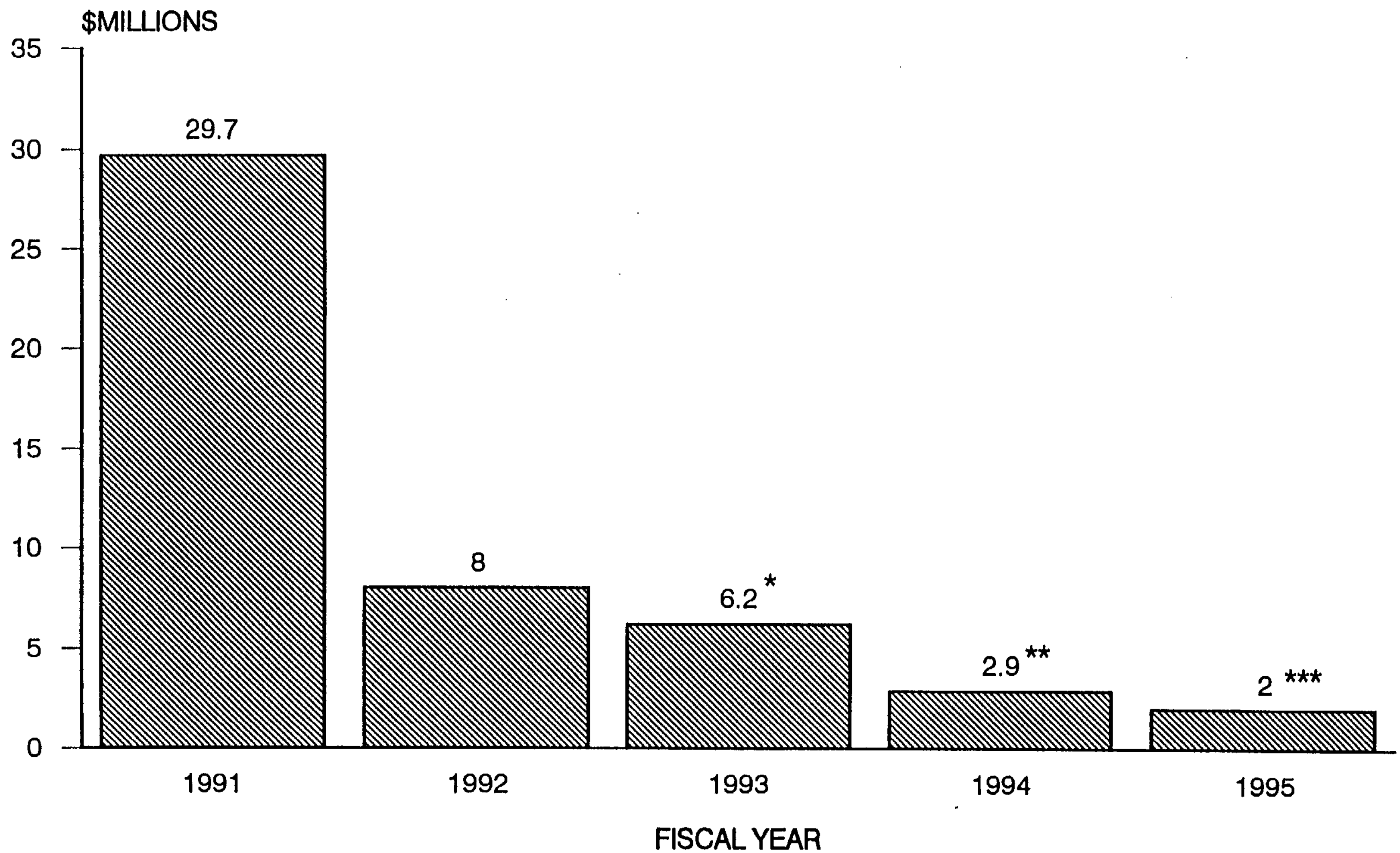
FY 1995 MATERIAL LOSSES DUE TO MISHAPS
NASA TOTAL * $1,989,401



* DOES NOT INCLUDE THE X-31 MISHAP. SEE PAGE 32 FOR DETAILS.
** INCLUDES TWO ROTOR BLADE MISHAPS AT LARC - 34%

Figure 10

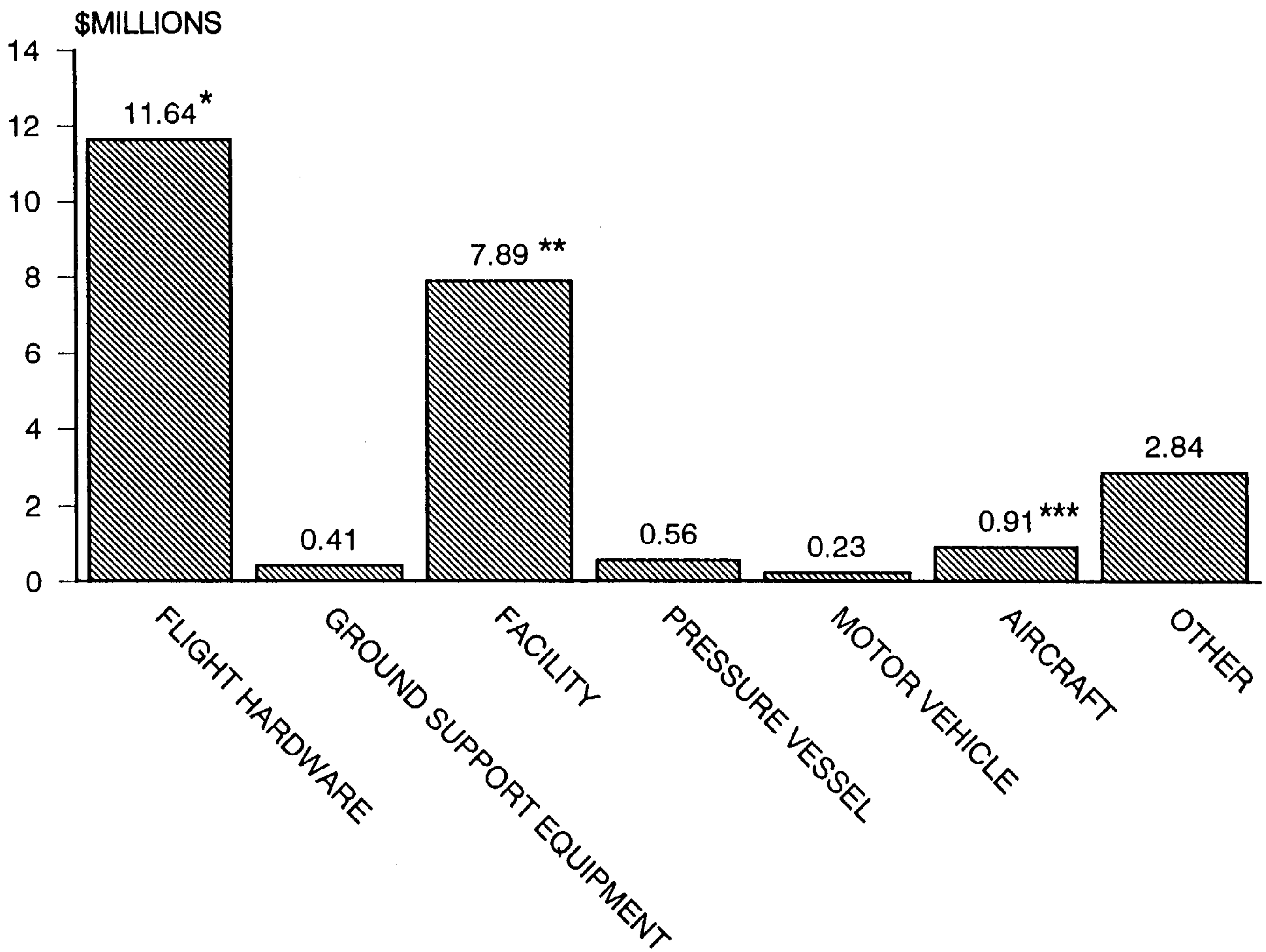
NASA MATERIAL LOSSES DUE TO MISHAPS
TOTAL COSTS



* DOES NOT INCLUDE LOSS OF THE MARS OBSERVER SPACECRAFT
** DOES NOT INCLUDE EARTHQUAKE DAMAGE AT CANOGA PARK
*** DOES NOT INCLUDE THE X-31 MISHAP

Figure 11

NASA MATERIAL LOSSES DUE TO MISHAPS
CATEGORY TOTALS FY 1991 - FY 1995



* DOES NOT INCLUDE LOSS OF MARS OBSERVER
** DOES NOT INCLUDE EARTHQUAKE DAMAGE AT CANOGA PARK
*** DOES NOT INCLUDE THE X-31 MISHAP

Figure 12

NASA MISHAP DEFINITIONS

The revised NASA Management Instruction for Mishap Reporting and Investigation (NMI 8621.1F), dated December 31, 1991, contains updated NASA mishap definitions. All mishaps reported in FY 1995 were categorized according to these definitions as follows:

1. **NASA MISHAP:** Any unplanned occurrence, event, or anomaly that meets one of the definitions below. Injury to a member of the public while on NASA facilities also is defined as a NASA mishap.

   a. **TYPE A MISHAP:** A mishap causing death and/or damage to equipment or property equal to or greater than $1,000,000. Mishaps resulting in damage to aircraft or space hardware, i.e., flight and ground support hardware, meeting these criteria are included. This definition also applies to a test failure if the damage was unexpected or unanticipated or if the failure is likely to have significant program impact or visibility.

   b. **TYPE B MISHAP:** A mishap resulting in permanent disability to one or more persons, or hospitalization (for other that observation) of five or more persons, and/or damage to equipment or property equal to or greater than $250,000 but less than $1,000,000. Mishaps resulting in damage to aircraft or space hardware which meet these criteria are included, as are test failures where the damage was unexpected or unanticipated.

   c. **TYPE C MISHAP:** A mishap resulting in damage to equipment or property equal to or greater than $25,000 but less than $250,000, and/or causing occupational injury or illness that results in a lost workday case. Mishaps resulting in damage to aircraft or space hardware which meet these criteria are included, as are test failures where the damage was unexpected or unanticipated.

   d. **MISSION FAILURE:** Any mishap (event) of such a serious nature that it prevents accomplishment of a majority of the primary mission objectives. A mishap of whatever intrinsic severity that, in the judgment of the Program Associate Administrator, in coordination with the Associate Administrator for Safety and Mission Quality (now Safety and Mission Assurance), prevents the achievement of primary mission objectives as described in the Mission Operations Report or equivalent document.

   e. **INCIDENT:** A mishap consisting of less than Type C severity of injury to personnel (more than first aid severity) and/or property damage equal to or greater than $1,000 but less than $25,000.

2. **NASA CONTRACTOR MISHAP:** Any mishaps as defined in Paragraphs 1a through 1e that involve only NASA contractor personnel, equipment, or facilities in support of NASA operations.

3. **IMMEDIATELY REPORTABLE MISHAPS:** All mishaps that require immediate telephonic notification to local and Headquarters safety officials. Included in this category are those mishaps defined in Paragraphs 1a through 1d and 2 with the exception of Type C injury/illness cases and incidents.

4. **CLOSE CALL:** An occurrence in which there is no injury, no significant equipment/property damage (less than $1,000), and no significant interruption of productive work, but which possesses a high potential for any of the mishaps as defined in Paragraphs 1a through 1e.

5. **OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) RECORDABLE MISHAP:** An occupational death, injury, or illness that must be recorded subject to OSHA requirements in 29 CFR Parts 1960 and 1910.

6. **COSTS:** Direct costs of repair, retest, program delays, replacement, or recovery of NASA materials including hours, material, and contract costs, but excluding indirect costs of cleanup, investigation (either by NASA, contractor, or consultant), injury, and by normal operational shutdown. Materials or equipment replaced by another organization at no cost to NASA will be calculated at "book" value. This includes those mishaps covered by insurance.

MISHAP STATISTICS

Tables 3 and 4 show the number of mishaps that were reported by the NASA Centers as having significance beyond the minor dollar losses or no-lost time injury category. These mishaps provide lessons learned for all NASA accident prevention programs.

Table 3 shows the number of fatalities experienced by NASA over the last 5 years categorized by Center. NASA experienced no mishap-related fatalities during FY 1995.

Table 4 shows the number of Type A, B, and C mishaps for each NASA Center over the last 5 years.

Figure 13 presents a 5-year history of all NASA Type A and B mishaps and a break down of Type C property damage and lost time mishaps.

Tables 5A and 5B provide a safety performance summary for FY 1995. Table 5A compares FY 1995 lost time injury/illness rates with each Center's goal and previous performance. Table 5B shows the number and type of mishaps and the cost of material losses for FY 1994 and FY 1995.

TABLE 3. FATALITIES - ANNUAL REPORT FY 1995

	1991	1992	1993	1994	1995
	N/ C/ O*	N/ C/ O	N/ C/ O	N/ C/ O	N/ C/ O
ARC	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
DFRC	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
GSFC/WFF	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
HQ	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
JPL	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
JSC/WSTF	0/ 0/ 1	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
KSC	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
LARC	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
LERC	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
MSFC	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
SSC	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0
TOTAL	0/ 0/ 1	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0	0/ 0/ 0

* N/ C/ O = NASA / Contractor / Other.

TABLE 4. NASA MAJOR MISHAPS BY INSTALLATION - ANNUAL REPORT FY 1995

	1991	1992	1993	1994	1995
	A/ B/ C	A/ B/ C	A/ B/ C	A/ B/ C	A/ B/ C
ARC	1/ 2/ 7	0/ 0/ 11	0/ 0/ 12	0/ 1/ 19	0/ 0/ 16
DFRC	0/ 0/ 5	0/ 0/ 5	0/ 0/ 9	0/ 0/ 1	1/ 0/ 2
GSFC/WFF	0/ 0/ 9	0/ 0/ 14	0/ 1/ 10	0/ 1/ 13	0/ 0/ 11
HQ	0/ 0/ 17	0/ 0/ 21	0/ 0/ 7	0/ 0/ 10	0/ 0/ 13
JPL	0/ 0/ 1	0/ 1/ 1	1/ 0/ 1	0/ 0/ 1	0/ 0/ 0
JSC/WSTF	0/ 1/ 13	0/ 0/ 15	0/ 0/ 13	0/ 1/ 9	0/ 0/ 5
KSC	1/ 0/ 8	0/ 0/ 11	0/ 0/ 8	0/ 0/ 11	0/ 0/ 6
LARC	0/ 0/ 9	0/ 0/ 9	0/ 0/ 9	0/ 1/ 9	0/ 1/ 8
LERC	0/ 0/ 11	0/ 0/ 16	0/ 1/ 9	0/ 0/ 17	0/ 1/ 5
MSFC	1/ 0/ 20	1/ 3/ 26	0/ 0/ 16	0/ 0/ 12	0/ 0/ 7
SSC	0/ 0/ 1	0/ 0/ 1	1/ 0/ 2	0/ 0/ 1	0/ 0/ 1
Canoga Park				*1/ 0/ 0	
TOTAL	3/ 3/101	1/ 4/130	2/ 2/ 96	*1/ 4/103	1/ 2/ 74

Includes NASA fatalities, permanent disabilities, hospitalization of 5 or more persons, lost time mishaps and Type A, B, & C property damage according to NMI 8621.1F.

* Northridge Earthquake.

NASA TYPE A, B, AND C MISHAPS

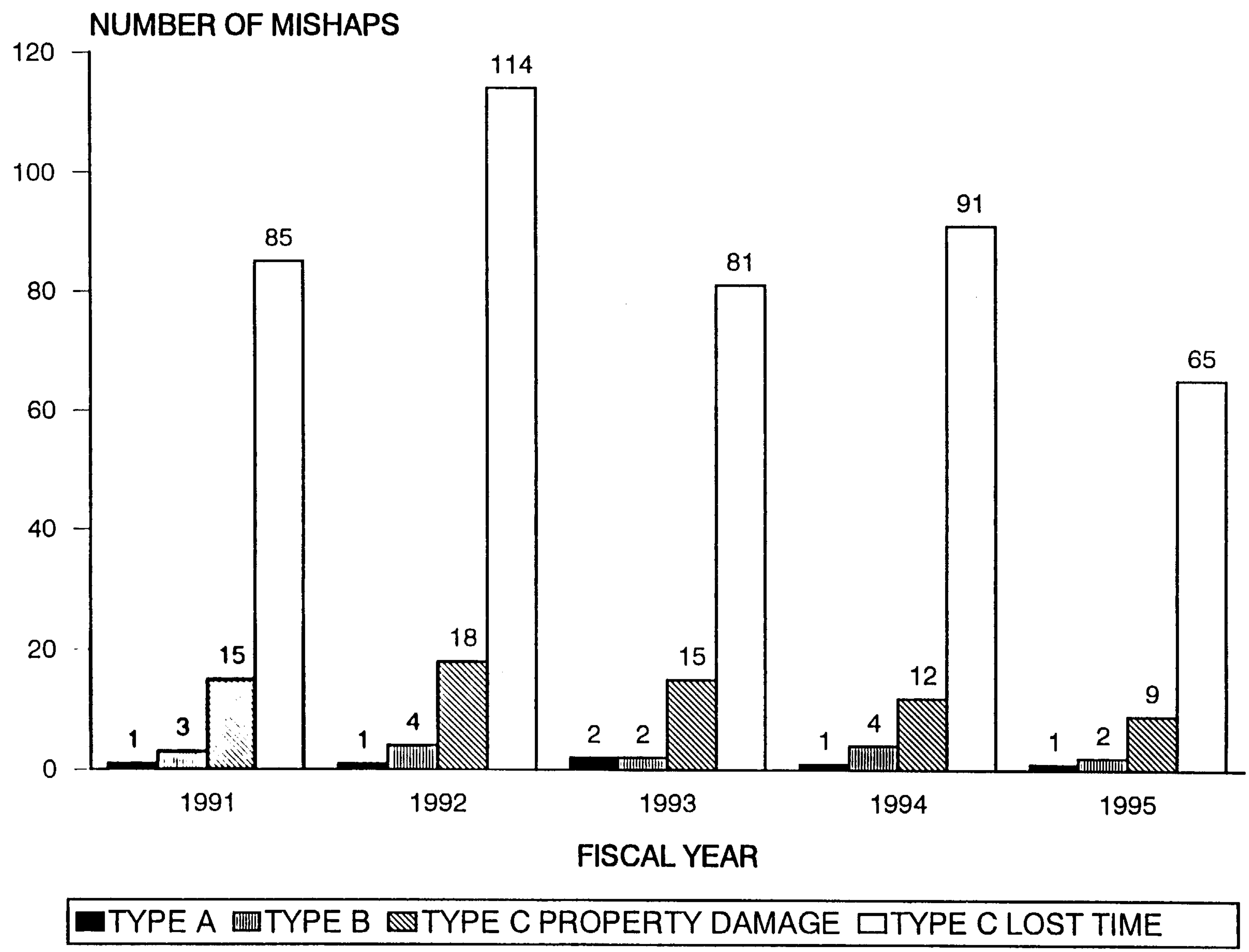


Figure 13

TABLE 5A. PERFORMANCE SUMMARY - ANNUAL REPORT FY 1995

NASA LOST TIME RATES

	1994	1995	GOAL 1995
ARC	1.08	0.72	0.59
DFRC	0.22	0.41	0.65
GSFC/WFF	0.42	0.30	0.38
HQ	0.39	0.85	0.47
JSC/WSTF	0.28	0.06	0.36
KSC	0.48	0.26	0.37
LARC	0.20	0.19	0.33
LERC	0.61	0.22	0.44
MSFC	0.29	0.21	0.38
SSC	0.50	0.44	0.42
NASA	0.43	0.31	0.40

TABLE 5B. PERFORMANCE SUMMARY - ANNUAL REPORT FY 1995

	TYPE A MISHAPS			TYPE B MISHAPS		TYPE C MISHAPS		MATERIAL LOSSES	
	1994	1995	(FATALITIES) 1995	1994	1995	1994	1995	1994	1995
ARC	0	0	0	1	0	19	16	414,500	22,946
DFRC	0	1	0	0	0	1	2	17,370	(**100,000,000)
GSFC/WFF	0	0	0	1	0	13	11	0	29,000
HQ	0	0	0	0	0	10	13	24,777	0
JPL	0	0	0	0	0	1	0	155,500	5,300
JSC/WSTF	0	0	0	1	0	9	5	710,941	391,677
KSC	0	0	0	0	0	11	6	59,862	107,992
LARC	0	0	0	1	1	9	8	914,000	773,009
LERC	0	0	0	0	1	17	5	130,881	485,845
MSFC	0	0	0	0	0	12	7	519,052	173,632
SSC	0	0	0	0	0	1	1	3,000	0
TOTALS	0	0	1	4	0	103	74	2,949,883	1,989,401
Canoga Park	*1							*10,000,000	

* Earthquake damage at Canoga Park.
** X-31 Mishap not included in totals. Details are provided on Page 32.

MAJOR MISHAPS

FY 1995

NASA 584 X-31 MISHAP
DRYDEN FLIGHT RESEARCH CENTER
TYPE A

On January 19, 1995, a U.S. Navy X-31 research aircraft was destroyed when it crashed just north of Edwards Air Force Base, California during the final flight of its test program. (The plane was destined to be a static museum exhibit.) The aircraft departed from controlled flight at 20,000 feet altitude as it accelerated and descended to return for landing. The pilot ejected successfully; although, he did sustain some serious, but non-life threatening injuries. The mishap investigation determined that the aircraft's departure from controlled flight was caused by icing in or around the Pitot tube. This led to incorrect total air pressure data being sent to the flight control computers by the Pitot-static system which resulted in the aircraft becoming unstable. The root causes of the mishap were inaccurate system safety analyses and a breakdown in appropriate dissemination of safety critical information. This research program was a combined effort between NASA, the U.S. Navy, and the Federal Armed Forces of Germany. The accident was considered a NASA Type A mishap and was investigated as such. However, none of the actual equipment/property damage costs were directly attributed to NASA. The value of the aircraft and the research equipment aboard was estimated at $100,000,000.

VARIABLE ACOUSTIC IMPEDANCE ROTOR BLADE
STRUCTURAL FAILURE
LANGLEY RESEARCH CENTER
TYPE B

Two of four prototype variable acoustic impedance rotor blades failed during a test run in the Rotor Test Cell Facility on April 21, 1995. The blades were mounted on the General Rotor Model System and were being accelerated from 1,400 rpm to the target operating speed of 1,450 rpm when the failure occurred. The blades were produced to investigate a technique for reducing blade vortex interaction noise. The most probable failure mode was determined to be fracture of the leading edge support structure due to non-uniform, chord-wise centrifugal loading. The accident investigation committee determined that the most probable cause of the mishap was failure to understand the loading conditions of the blades. The research requirements led to non-standard internal blade architecture. The result was a rotor blade design which could not structurally withstand the intended operating conditions. The final cost of the mishap was $457,200.

FLOODING OF THE BASEMENT UNDER THE ADVANCED SUBSONIC COMBUSTION RIG FACILITY LEWIS RESEARCH CENTER TYPE B

On September 14, 1995, the basement of Building 38, under the Advanced Combustion Rig facility, was flooded to a depth of 47 inches. Damage was sustained to various equipment including motors, facility controls, and switchgear. There were no personnel injuries. The primary cause of the accident was the separation of an unattended 2-inch bypass hose connecting the cooling tower water supply to the cooling tower water pressurized return. This temporary connection had been made as part of an effort to flush debris and sediment from the supply line. It was determined that the hose was connected improperly, using some inappropriate materials and methods. Over time and under approximately 60 pounds of pressure, the hose slipped off the pipe nipple on the supply side connection. Due to the large volume of water flowing onto the floor from both the cooling tower water supply and the back flow from the cooling tower pumped return, the existing basement area sump pump could not keep up with the demand. The final cost of the mishap was $473,300.

TYPE C MISHAPS
EQUIPMENT/PROPERTY DAMAGE

Goddard Space Flight Center/Wallops Flight Facility
The telescoping boom of a 60-ton mobile crane was accidentally retracted while maintenance was being performed on some of the crane's electrical circuits. Damage was sustained to welds on the crane's pulley assembly. The primary cause of the mishap was determined to be a procedure deficiency. Lack of proper training was a contributing factor. The final cost of the mishap was $29,000.

Johnson Space Center
The Dart engines of a NASA aircraft (NASA 2, G-159) sustained damage during a flight on October 27, 1994. The co-pilot was performing the check list while the pilot was flying the aircraft and climbing to turn downwind. As the co-pilot reached the check list item which read "Water Methanol - As Required" he incorrectly armed the switch. Because the aircraft was climbing at a high power setting, the movement of the switch caused an instantaneous flow of water methanol resulting in both engines exceeding their operating limits. The pilot retarded the throttles, turned the water methanol off, and made an uneventful landing. The primary cause of the mishap was misjudgement of conditions. The final cost was $150,000.

During the test of an electronic assembly in the Satellite Interface Test Area, an oscilloscope ground was accidentally applied to a pin connected to a motor drive circuit. The motor drive circuit was overloaded and failed. The primary cause of the mishap was misjudgement of conditions. The final cost of the mishap was $50,000.

An auxiliary power unit on NASA aircraft N-947 failed during pre-flight operations. Several metal pieces were exhausted onto the ramp. An inspection of the unit revealed major internal failure. Final cost of the mishap was $70,000.

Kennedy Space Center
A transducer was found to be damaged when it was removed from its packaging. The part was inspected by the manufacture at its source. It was received from the vendor in October 1994 and was inspected for packaging which showed no sign of damage. Due to its sensitive nature, the packaging was not opened. The part was put in stock and was issued to the Avionics Lab for assembly in the Air Data Transducer Assembly in March 1995. The mishap investigation was unable to determine the event that caused the damage or the custodian of the transducer when the damage occurred. The final cost of the mishap was $46,908.

Langley Research Center

An electrical fault caused a fire and damage to switch gear in an electrical substation on April 21, 1995. The primary cause of the mishap was equipment failure due to material failure. The final cost of the mishap was $58,000.

An instrumentation rack for the Advanced Control Test Facility sustained damage when it was dropped while being moved. The primary cause of the mishap was a deviation from proper handling procedures. The final cost of the mishap was $40,120.

Low noise "dog-leg" prototype rotor blades failed during a demonstration run-up activity in the Rotor Test Cell Facility on May 24, 1995. One of the blades sustained a fracture resulting in separation while the other three were only cracked. The most probable cause of the mishap was determined to be failure to understand the loading conditions of the blades. The research required the employment of an unusual planform design. Software that could thoroughly assess the behavior of the blades during run-up was not available at the time the blades were designed and fabricated. The result was a rotor blade design that could not withstand the intended operating conditions. Final cost of the mishap was $216,889.

Marshall Space Flight Center

A Space Shuttle Main Engine Oxidizer Preburner manifold was damaged during a machine operation at the manufacturer's facility. The manifold was being machined on a 5-axis mill when the mill's "Y" axis coupling broke. The machine mispositioned and the manifold's wall thickness was undercut. The part could not be repaired and had to be scrapped. The primary cause of the mishap was equipment failure due to material failure. The cost of the mishap was estimated at $97,819.